

[Table 1]

Steel No.	C	Si	Al	Si+Al	Mn	P	S	Cr	Mo	Others	Ae ₁	Ae ₃
1	0.003	1.5	0.03	1.53	1.5	0.02	0.005	-	-		751	921
2	0.11	1.5	0.03	1.53	1.5	0.02	0.006	-	-		751	865
3	0.20	1.5	0.03	1.53	1.5	0.01	0.005	-	-		751	841
4	0.41	1.5	0.03	1.53	1.5	0.01	0.004	-	-		751	802
5	0.60	1.5	0.03	1.53	1.5	0.02	0.006	-	-		751	775
6	0.20	1.5	0.03	1.53	1.5	0.01	0.004	0.3	0.1		756	841
7	0.21	1.5	0.03	1.53	1.5	0.02	0.004	-	-	Ni:0.30, Cu:0.30	751	828
8	0.20	1.5	0.03	1.53	1.5	0.01	0.005	-	-	Ti:0.03	751	841
9	0.19	1.5	0.03	1.53	1.5	0.01	0.006	-	-	REM:0.02	751	844
10	0.20	1.5	0.03	1.53	1.5	0.02	0.006	-	-	B:0.008	751	841
11	0.20	0.3	0.03	0.33	1.5	0.02	0.006	-	-		716	788
12	0.41	0.2	0.80	1.00	1.5	0.01	0.006	-	-		713	744

[Table 2]

No.	Steel No.	Manufacturing Conditions		Base Phase Structure	Second Phase Structure						Mechanical Characteristics				
		Method	Working Ratio		F	γ_R	$[\gamma_R] / [C]$	Others	d	V*	TS	EL	RA	TS*RA	
1	1	C	50	100	0	0	0	0	-	-	472	33	70	33040	
2	2	A	50	78	0	0	0	22	-	-	610	21	24	14640	
3	2	B	50	72	10	91	18	4.3	31	31	622	31	35	21770	
4	2	C	50	74	12	109	14	2.2	0	0	639	33	57	36423	
5	3	A	50	72	0	0	0	28	15.0	0	830	18	15	12450	
6	3	B	50	65	13	65	22	4.8	27	27	812	28	27	21924	
7	3	C	50	68	15	75	17	1.6	0	0	860	26	49	42140	
8	3	C	10	58	12	60	30	2.2	3	3	824	27	45	37080	
9	3	C	20	62	13	65	25	2.3	0	0	832	26	44	36608	
10	3	C	30	70	15	75	15	2.0	4	4	840	26	45	37800	
11	3	C	40	59	15	75	26	1.9	0	0	855	28	45	38475	
12	3	C	60	61	15	75	24	1.6	0	0	861	28	46	39606	
13	3	C	70	68	15	75	17	1.7	2	2	870	29	49	42630	
14	4	A	50	56	0	0	44	18.3	0	0	1298	10	16	20768	
15	4	B	50	51	25	63	24	6.1	29	29	1322	23	21	27762	
16	4	C	50	55	27	68	18	1.9	0	0	1348	25	42	56616	
17	5	A	50	35	4	7	61	14.5	0	0	1499	6	5	7495	
18	5	B	50	41	33	55	26	4.5	33	33	1561	19	14	21854	
19	5	C	50	39	35	58	26	1.7	5	5	1533	21	37	56721	
20	6	C	50	62	14	70	24	2.2	0	0	991	24	41	40631	
21	7	C	50	58	13	62	29	2.0	0	0	966	25	46	44436	
22	8	C	50	58	14	70	28	2.3	0	0	940	27	51	47940	
23	9	C	50	66	14	74	20	2.1	0	0	855	25	49	41895	
24	10	C	50	59	13	65	28	1.8	4	4	888	24	47	41736	
25	11	C	50	55	2	10	43	2.0	0	0	673	22	32	21536	
26	12	C	50	52	25	61	23	2.1	0	0	911	24	44	40084	

Note: F = Ferrite, γ_R = Retained austenite, Others = Bainite and/or martensite,

d = Average grain diameter of the second phase structure,

V* = Space factor of a coarse second phase structure in the second phase structure

[Table 3]

Steel No.	C	Si	Al	Si+Al	Mn	P	S	Cr	Mo	Others	Ae ₁	Ae ₃
1	0.003	1.5	0.03	1.53	1.5	0.02	0.005	-	-		751	921
2	0.11	1.5	0.03	1.53	1.5	0.02	0.006	-	-		751	865
3	0.20	1.5	0.03	1.53	1.5	0.01	0.005	-	-		751	841
4	0.41	1.5	0.03	1.53	1.5	0.01	0.004	-	-		751	802
5	0.60	1.5	0.03	1.53	1.5	0.02	0.006	-	-		751	775
6	0.20	1.5	0.03	1.53	1.5	0.01	0.004	0.3	0.1		756	841
7	0.21	1.5	0.03	1.53	1.5	0.02	0.004	-	-	Ni:0.30, Cu:0.30	751	828
8	0.20	1.5	0.03	1.53	1.5	0.01	0.005	-	-	Ti:0.03	751	841
9	0.19	1.5	0.03	1.53	1.5	0.01	0.006	-	-	REM:0.02	751	844
10	0.20	1.5	0.03	1.53	1.5	0.02	0.006	-	-	B:0.008	751	841
11	0.20	0.3	0.03	0.33	1.5	0.02	0.006	-	-		716	788
12	0.41	0.2	0.80	1.00	1.5	0.01	0.006	-	-		713	744

[Table 4]

No.	Steel No.	Manufacturing Conditions		Base Phase Structure		Second Phase Structure						Mechanical Characteristics			
		Method	Working Ratio	TM	TB	PF	γ _R	M	B	V*	TS	EL	RA	TS*RA	
1	1	C	50	82	0	18	0	0	0	-	477	32	72	34344	
2	2	A	50	0	0	22	0	78	0	0	610	21	24	14640	
3	2	B	50	0	0	72	10	6	12	91	622	31	35	21770	
4	2	C	50	78	0	0	12	3	7	0	661	35	71	46931	
5	3	A	50	0	0	28	0	72	0	0	830	18	15	12450	
6	3	B	50	0	0	65	13	7	15	85	812	28	27	21924	
7	3	C	50	76	0	0	16	3	5	0	865	26	61	52765	
8	3	C	10	81	0	0	13	2	4	3	831	27	55	45705	
9	3	C	20	79	0	0	13	4	4	0	835	27	65	54275	
10	3	C	30	77	0	0	14	4	5	4	847	28	63	53361	
11	3	C	40	76	0	0	15	3	6	0	870	29	55	47850	
12	3	C	60	75	0	0	16	3	6	0	869	28	63	54747	
13	3	C	70	76	0	0	15	3	6	2	885	28	60	53100	
14	4	A	50	0	0	14	0	86	0	0	1298	10	16	20768	
15	4	B	50	0	0	51	25	8	16	89	1322	23	21	27762	
16	4	C	50	66	0	0	26	2	6	0	1355	26	53	71815	
17	5	A	50	0	0	5	4	95	0	0	1499	6	5	7495	
18	5	B	50	0	0	41	33	9	17	83	1561	19	14	21854	
19	5	C	50	55	0	0	32	4	4	32	1546	21	19	29374	
20	6	C	50	0	76	0	15	2	7	0	1003	24	55	55165	
21	7	C	50	0	77	0	14	3	6	0	1010	26	57	57570	
22	8	C	50	0	78	0	13	3	6	0	999	27	53	52947	
23	9	C	50	0	77	0	15	3	5	0	879	26	54	47466	
24	10	C	50	0	77	0	13	4	6	4	898	25	53	47594	
25	11	C	50	89	0	0	2	3	6	82	687	18	36	24732	
26	12	C	50	68	0	0	24	2	6	0	923	24	49	45227	

Note: TM = Tempered martensite, TB = Tempered bainite, F = Ferrite, γ_R = Retained austenite,

M = Martensite, B = bainite,

V* = A proportion of a portion of retained austenite and martensite which portion is 2 or less in an aspect ratio